

**UNIVERSITY OF MAINE AT FARMINGTON**

**COLLEGE OF EDUCATION, HEALTH AND REHABILITATION**

**LESSON PLAN FORMAT**

**Teacher’s Name:**Sarah Fredrick **Lesson #:** 1 **Facets:** Explain and Perspective   
**Grade Level:** High School **Numbers of Days:** 5   
**Topic:** Probability Distribution and Expected Value  
  
**PART I:**  
  
**Objectives**  
**Student will understand that**the probability distribution is everywhere in real life and the expected value is related to the probability distribution  
**Student will know**Definitions - probability, expected value, probability distribution, random variable, mean, median, standard deviation, standard error, Formulas - expected value formula, probability distribution formula  
**Student will be able to**describe the probability distribution and compare and contrast the probability distribution and expected value  
**Products:**[GeoGebra](http://www.geogebra.org/) and [PostermyWall](http://www.postermywall.com/)

**Maine Learning Results (MLR) or Common Core State Standards (CCSS) or Next Generation Science Standards (NGSS) Alignment**  
**Common Core State Standards**  
**Content Area**: Statistics and Probability  
**Grade Level**: High School  
**Domain**: Using Probability to Make Decisions  
**Cluster**: Calculate expected values and use them to solve problems  
**Standards**: 2. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.  
**Rationale:**This standard will be addressed in this lesson because the teacher will be teaching the students how to calculate expected value and will be showing the students what the probability distribution looks like on a graph. The students will be comparing the two in a formative assessment.   
  
**Assessments**  
**Pre-Assessment: (Lesson 1 only)** Teacher will give a survey on what students know about probability distribution and expected value.  
**Formative (Assessment for Learning)**  
**Section I – checking for understanding strategy during instruction**  
Students will be thinking about what they already know and what they want to learn by putting what they want to learn on round sticky notes and then placing them on the bubbles of bubble wrap. When they know the concept they can pop the bubble. Students will take a quiz at the end of the lesson to see what they understand.  
**Section II – timely feedback for products (self, peer, teacher)**   
Peers will use a check list to make sure they have certain things in their PostermyWall for expected value and the probability distribution. Students will use a checklist for their GeoGebra probability distribution. As the teacher I will use the checklist and give written feedback on the checklist. As the teacher I will use a checklist to give written feedback on the distributions that students created using GeoGebra.  
**Summative (Assessment of Learning):**   
GeoGebra: Students will use GeoGebra to draw the probability distribution by plotting points and drawing lines in between the points. Students will label the mean, median, mode, standard deviation, and expected value of the probability distribution by plotting each part as points and labeling them as such. Students must show their work on how they got their values. 20 points  
PostermyWall: Students will work with a partner to make a poster using PostermyWall that explains what expected value is and what the probability distribution is. Students will compare and contrast the probability distribution and expected value on the poster. Students will be expected to have graphs and effects on their poster. 10 points  
  
**Integration**  
**Technology (SAMR):**  
Students will create a poster on PostermyWall comparing expected value and the probability distribution. This is at the augmentation level because students will have effects (pictures coming in at different times) on their posters.  
Students will create a graph of the probability distribution using GeoGebra. This is at the augmentation level because students can plot points and have GeoGebra create the graph and label the points. Students can also change the colors of the points and name them based on what it is instead of having point A and point B.   
**Content Areas:**   
Art. Students will be drawing the probability distribution for the lesson and the products. For their PostermyWall, students will need to include pictures which can be hand-drawn.  
  
**Groupings**  
**Section I - Graphic Organizer & Cooperative Learning used during instruction**  
Students will use [venn diagrams](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf) to compare and contrast expected value and probability distribution which will help students prepare for their PostermyWall project.  
As the teacher I will use [Rally Robin](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf) to review how mean, median, expected value, etc. relate to the probability distribution to help students review for a quiz. (in pairs or in a group)  
**Section II – Groups and Roles for Product**  
PostermyWall - students will be working in pairs to create a PostermyWall. One person will compare expected value and the probability distribution and the other person will contrast them. Both students will be responsible for putting together the PostermyWall. Students will be peer reviewing other pairs PostermyWall.   
GeoGebra - students will be working individually but they will share their product with another student in class to compare their product with someone else's product.  
**Differentiated Instruction**  
**MI Strategies**  
**Verbal:** Students will be talking with their peers about how they think mean, median, etc. relate to the probability distribution during [Rally Robin.](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf)  
**Logic:** Students will be thinking about what they want to know for the [pop it](http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf)activity.  
**Visual:** Students will be creating a [Venn Diagram](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf) that compares and contrasts the probability distribution and expected value.  
**Musical:** Students will listen to the [Probability Song](https://www.youtube.com/watch?v=0xm1SDlnvh4) on YouTube.  
**Intrapersonal:** Students will create the probability distribution on GeoGebra and label its part on their own.  
**Interpersonal:** Students will work in pairs to create a PostermyWall that compares and contrasts the probability distribution and expected value.  
  
**Modifications/Accommodations**  
**From IEP’s ( Individual Education Plan), 504’s, ELLIDEP (English Language Learning Instructional Delivery Education Plan)**I will review student’s IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.  
**Plan for accommodating absent students:**   
  
If you are absent, it is the student's responsibility to make up the assignments and/or tests when they return. All homework assignments are posted on my class website. This includes classes missed for field trips and sports events. It is the student's responsibility to come in at lunch or after school to catch up on missed work from their absences. You should get the notes that you missed from another student before meeting with me. If students are absent on the day of a test, they will be expected to make up the test on the next day that they are in school. There are exceptions for extended absences but the student must come see me the day they get back to school. For this lesson students will be expected to get the notes from another student as well as see the teacher since this is the baseline for the rest of the work that we will do in this unit. If we are working on the PostermyWall, the partner will be in charge of contacting the student and letting them know what they are doing. If the student is absent for an extended period of time and misses the entire PostermyWall assignment, another assignment will be provided. If we are working on the GeoGebra graph the student will be required to come in and see the teacher so they can learn how to use the technology since it will be used later on in the unit. Students will be given an extension to get the work done on this assignment if they are absent for an extended period of time.   
  
**Extensions**  
**Technology (SAMR): Gifted Students:**   
The PostermyWall project can be brought up to the modification level by the student posting it online (with the permission of their partner) on a website that explains the probability distribution or on a website that publishes student work.   
The GeoGebra graph can be brought to the modification level by the student researching someone who needs to use the distribution to solve a problem. The student will create their distribution around the problem that it is needed for and send it to the person to help them make an informed decision.  
  
**Materials, Resources and Technology**  
White board & markers  
Projector/ Smart Board  
Laptops for the students  
[Venn Diagram handouts](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf)  
Checklists for both products  
Pre - assessment  
Index cards  
Quizzes  
Bubble Wrap  
Sticky notes  
Coins  
  
**Source for Lesson Plan and Research**  
<http://www.eduplace.com/graphicorganizer/pdf/venn.pdf>. Students will use print outs of this Venn Diagram to compare and contrast expected value and the probability distribution.  
<http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf>. The teacher will use the Rally Robin activity from this website as a cooperative learning strategy.  
<https://www.youtube.com/watch?v=0xm1SDlnvh4>. The teacher will use this song on YouTube as a hook into the lesson.  
<https://www.khanacademy.org/math/probability/descriptive-statistics>. Teacher will use some of the content that is covered on Khan Academy and will offer the link to the students as a resource to help them review what was done in class.  
<http://www.cliffsnotes.com/study-guides/statistics/numerical-measures/quiz-measures-of-central-tendency>. Teacher will provide this as a resource for students to review for their quiz. The teacher will also look at the questions on this site when creating the quiz.  
<http://www.mhhe.com/cgi-bin/netquiz_get.pl?qfooter=/usr/web/home/mhhe/socscience/psychology/dunn/quizzes/test4fq.htm&test=/usr/web/home/mhhe/socscience/psychology/dunn/quizzes/test4q.txt&answers=/usr/web/home/mhhe/socscience/psychology/dunn/quizzes/test4a.txt&email=1>.  
Teacher will provide this as a resource for students to review for their quiz. The teacher will also look at the questions on this site when creating the quiz.  
<https://onlinecourses.science.psu.edu/stat200/node/36>. The teacher will use this site to help create content notes and to help plan what s/he is going to teach.  
<https://www.khanacademy.org/math/probability/random-variables-topic/expected-value/v/expected-value-wager>. The teacher will use this site to teach about expected value. The students will be given the website as a resource to use when they are creating their PostermyWall.  
<https://www.khanacademy.org/math/probability/random-variables-topic/random_variables_prob_dist/v/discrete-probability-distribution>. The teacher will use this website to help explain how to construct probability distributions to the students. Students will also have this as a resource when they are creating their graphs using GeoGebra.  
<https://www.geogebra.org/wiki/en/Probability_Calculator>. Tutorial for Probability section of GeoGebra.  
<https://tube.geogebra.org/b/1145995#chapter/35543>. Tutorial for probability and statistics for GeoGebra.  
<https://www.youtube.com/watch?v=u5be9UnGe1Y>. Tutorial for PostermyWall  
<https://www.youtube.com/watch?v=SUMnbTdzPB4>. Tutorial for PostermyWall  
<https://www.youtube.com/watch?v=dIESU2ttiHE>. Tutorial for PostermyWall  
<http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf> List of checking for understanding strategies.  
<http://dictionary.reference.com/browse/probability> probability definition.  
<http://www.investopedia.com/terms/e/expected-value.asp> expected value definition  
<http://www.investopedia.com/terms/p/probabilitydistribution.asp> probability distribution definition  
<https://en.wikipedia.org/wiki/Random_variable> random variable definition  
<https://en.wikipedia.org/wiki/Mean> definition of mean  
<https://en.wikipedia.org/wiki/Median> definition of median   
<https://en.wikipedia.org/wiki/Standard_deviation> definition of standard deviation   
<http://www.investopedia.com/terms/s/standard-error.asp> definition of standard error  
<http://statistics.about.com/od/Formulas/a/What-Is-The-Formula-For-Expected-Value.htm> expected value formula  
<http://formulas.tutorvista.com/math/probability-distribution-formula.html> probability distribution formula  
<https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php> measures of central tendency definition  
**PART II:**  
  
**Teaching and Learning Sequence**

**Classroom Arrangement:**   
The classroom will have three rows made up of two desks pushed together. The desks will be facing the board. There will be a table with lined paper and other supplies that the students may need for the lesson.

**Agenda:**   
Day 1: Getting to know each other. (15 minutes)  
Introduction to what the unit will be about. (15 minutes)  
Pre- assessment. (20 minutes)  
[Bubble Wrap](http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf)checking for understanding activity. (15 minutes)  
Start lesson on [expected value](https://www.khanacademy.org/math/probability/random-variables-topic/expected-value/v/expected-value-wager) (15 minutes)  
Day 2: Learning about[expected value](https://www.khanacademy.org/math/probability/random-variables-topic/expected-value/v/expected-value-wager) and the [probability distribution](https://www.khanacademy.org/math/probability/random-variables-topic/random_variables_prob_dist/v/discrete-probability-distribution). (45 minutes)  
Introduction to [measures of central tendency](https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php). (15 minutes)  
Introduction to [PostermyWall](http://postermywall.com/) project and time to meet with partners. Start working on project (20 minutes)   
Day 3: Learning about measures of central tendency. (40 minutes)  
[Rally Robin](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf). (20 minutes)  
Time to work on PostermyWall Project. (20 minutes)  
Assignment: Finish Poster on Postermywall, email/share with teacher, be ready to present in the beginning of class tomorrow.  
Day 4: Presenting PostermyWall project. (40 minutes)  
Peer review activity. (15 minutes)  
Reviewing [measures of central tendency](https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php). (20 minutes)  
Introduction to [GeoGebra](http://geogebra.org/) Project. (5 minutes)  
Assignment: study for quiz on measures of central tendency. Look at the tutorials for [GeoGebra](https://www.geogebra.org/wiki/en/Probability_Calculator).  
Day 5: Quiz on measures of central tendency. (25 minutes)  
Time to work on GeoGebra Project and share with classmates. (55 minutes)  
Assignment: GeoGebra project due tomorrow.

**Teaching and Learning Sequence**

Students will understand that the probability distribution is everywhere in real life and the expected value is related to the probability distribution. The standard that will be addressed in this section is 2. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. After the getting to know the teacher/ students part of the first day, the teacher will give the students a pre-assessment so the teacher can see what students already know about probability and the concepts that will be taught in the lesson. The teacher will use the pre-assessment to modify the lessons if it is needed. The students will not see their scores or the pre-assessment until the end of the unit when they take the same quiz as a post- assessment. The teacher will start the lesson by playing the [probability song](https://www.youtube.com/watch?v=0xm1SDlnvh4)on YouTube. This will tell students different types of probability that they will be learning in this unit. It will [hook](https://www.youtube.com/watch?v=0xm1SDlnvh4) the students in because the information is set to a popular song instead of having the teacher stand in the classroom and list things off. Students can figure out how often a coin will land heads or tails which relates to something they do outside of the classroom, especially athletes. After the song, students will be given coins and asked to flip them 25 times and record how many times the coin landed heads and how many times it landed tails. Data will be gathered from the entire class to introduce the probability unit.  
**Where, Why , What, Hook Tailors:** Logical, Visual, Musical, Intrapersonal, Interpersonal  
  
Students will know [probability](http://dictionary.reference.com/browse/probability), [expected value](http://www.investopedia.com/terms/e/expected-value.asp), [probability distribution](http://www.investopedia.com/terms/p/probabilitydistribution.asp), [random variable](https://en.wikipedia.org/wiki/Random_variable), [mean](https://en.wikipedia.org/wiki/Mean), [median](https://en.wikipedia.org/wiki/Median), [standard deviation](https://en.wikipedia.org/wiki/Standard_deviation), [standard error](http://www.investopedia.com/terms/s/standard-error.asp), [expected value formula](http://statistics.about.com/od/Formulas/a/What-Is-The-Formula-For-Expected-Value.htm), [probability distribution formula](http://formulas.tutorvista.com/math/probability-distribution-formula.html). (see content notes). During this lesson the teacher will handout [Venn diagrams](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf) for students to use so they can compare and contrast expected value and probability distribution. The teacher will check to make sure that they are complete but they are mainly for students to use in preparation for their project where they will compare and contrast the two. The teacher will not explicitly go over the [graphic organizer](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf) in class but students will be able to fill it out as they take notes. Students can fill it out in class or they can complete the [graphic organizer](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf) outside of class when they are looking over their notes. The [cooperative learning activity](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf) that will be used in this lesson is [Rally Robin](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf). In [Rally Robin](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf)the teacher will pose a question about how expected value and the measures of central tendency relate to the [probability distribution](https://www.khanacademy.org/math/probability/random-variables-topic/random_variables_prob_dist/v/discrete-probability-distribution). The students will be split into teams. Teams will be created by the teacher giving students numbers 1-4. The 1's will be in one group, the 2's in another, etc. The teacher will give people numbers according to their mastery level. By doing this the teacher is making sure that not all the gifted kids are in one group and not all the struggling students are in a group. This activity will serve as learning stations. Each team will be at a learning station and each station will have a question regarding one of the measures of central tendency. Each station will have different measure of central tendency to review. This will help students review for their quiz on the measures of central tendency and will clear up and misconceptions about how the measures of central tendency or expected value relate to the probability distribution. This [cooperative learning activity](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf) will also help students clear up any misconceptions about how the measures of central tendency relate to the probability distribution before they start creating their graph using GeoGebra. On the first day students will be given a piece of [bubble wrap](http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf)and round sticky notes. Students will write down on the sticky notes what they want to learn in the unit as well as a list of things that the teacher told students they would be learning in the unit. The students will put one sticky note on each bubble. The teacher will collect the bubble wrap and will see what the students wanted to learn and see if s/he can fit it into the unit or if it goes into another unit. The teacher will give the students the bubble wrap back at the end of each lesson and they can pop the bubbles that they now fully understand. The teacher will give the students a quiz on how the measures of central tendency relate to the probability distribution. The quiz will be used to check for understanding. The teacher will clear up any material that was gotten wrong on the quiz and make sure the students have the correct answers since the material will show up in other lessons.  
**Equip, Explore, Rethink, Tailors:** Interpersonal, Verbal, Logical, Visual  
  
**Student will be able to**describe the probability distribution and compare and contrast the probability distribution and expected value. In this lesson students will be creating two products. The first product that students will be creating is the poster using PostermyWall. Students will be working in pairs during this project. The teacher will group the students by having them work with the person who they are sitting next to. If students are sitting next to someone then the teacher will move them so they are sitting next to someone to work with. The teacher will give each partner a number, either 1 or 2. The 1's will be comparing the probability distribution and expected value. The 2's will be contrasting the probability distribution and expected value. The teacher will use the tutorials during the class time that has been set aside to introduce the project. Students will be shown where they can find the links on the teacher’s website this way they can use them outside of class. The pairs can self-assess their work because they will be provided with the checklist that the teacher will use to grade their products. Students will also be peer reviewing for this product. Students will be giving their peers feedback while they present. This feedback will be handed in to the teacher at the end of the class and the teacher will filter and type up the feedback for each student this way they can't tell who wrote what. The feedback given by peers and the teacher will be given to the students and they will have an opportunity to revise and refine their work. The second product that students will be creating in this lesson is a graph using GeoGebra. Students will create this product on their own. Students will be self-assessing their work as they create it. Students will be given the checklist that the teacher will use when grading the product and should make sure they have all the components on the checklist before emailing it to the teacher. Students will be given time in class to compare their products to their peers before turning in the project. Students will be allowed to refine their products after they get feedback from the teacher.  
**Experience, Revise, Refine, Tailors:** Intrapersonal, Interpersonal, Visual, Logical, Verbal  
  
The teacher will give feedback on both products. The teacher will use a checklist for the GeoGebra and PostermyWall projects. The teacher will use the checklist to see if students have the important components in their products. The teacher will provide written feedback on both checklists so that students know why one of things wasn't checked off as well as written feedback that explains their grade. The teacher will fill out the checklist and given written feedback while the students are presenting the PostermyWall and will give the feedback to the students at the end of class. The teacher will have the checklist when looking at the graphs students made using GeoGebra. The teacher will do this as the students email the products to the teacher. The teacher will give the feedback to the students the day after the project is due. Knowing the parts of the probability distribution and knowing how expected value relates to the probability distribution will help students in the next lessons when they are solving problems and making decisions using probability.   
**Evaluate, Tailors:** Interpersonal, Intrapersonal, Visual  
  
**Teacher Content Notes**  
Day 1: The teacher will start off the class by going over the syllabus and giving copies to each student. The syllabus will go over what is expected of the students throughout the unit. After going over the syllabus the teacher will make sure that she goes over the environment expectations in her classroom to ensure that the classroom is a safe environment to all students. It is important that the teacher do this to make sure that the students feel like her classroom is somewhere they want to be and somewhere students can share their thoughts and opinions without worrying about negative comments. The teacher will also go over how students can get to her website and where resources and homework will be listed. The teacher will tell the students some information about herself and then learn a little about the students such as their names and something that they like to do in their space time. The teacher will then give each student a note card. The students will put their name, their email address, and something they look forward to about the coming school year on the note card. Students will then take a quiz about what learning style they are which they will also put on the note card. The teacher will then give an introduction to what the students will be learning about in the unit. In this unit students will be learning about probability and how it can be used to solve problems and make decisions. They will learn how terms that they have used in previous math class, such as [mean](https://en.wikipedia.org/wiki/Mean), [median](https://en.wikipedia.org/wiki/Median), and mode, relate to what they will be learning about in the unit and throughout the course of the class. The teacher will then give students 20 minutes to take a pre-assessment to see what students already know about what will be taught in the unit so that the teacher can modify the lesson plans if need be. The teacher will then play the [Probability Song](https://www.youtube.com/watch?v=0xm1SDlnvh4) on YouTube to hook students into the first lesson of the unit. After the song the teacher will give students a piece of [bubble wrap](http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf) as well as round sticky notes. The students will be writing down what they want to learn in the unit on sticky notes and putting one sticky note on each bubble. As the students are doing this the teacher will write concepts on the board that students will include on their bubble wrap. The concepts that the teacher will be writing on the board is measures of central tendency, expected value, decision making, problem solving, real world examples and probability distribution. The teacher will then explain that student will be using the bubble wrap as a self - assessment because they will be given it back at the end of each lesson and they pop the bubbles of the subjects that they feel they have mastered. Students will use one of the sticky notes to write their name on and put that on one of the bubbles. The teacher will then collect the bubble wrap and keep in the classroom. The teacher will then start the lesson on probability in the remaining class time. The teacher will tell students the definition of [expected value](http://www.investopedia.com/terms/e/expected-value.asp). [Expected value](http://www.investopedia.com/terms/e/expected-value.asp)is the predicted value for a given event. The teacher will then talk about the [expected value formula](http://statistics.about.com/od/Formulas/a/What-Is-The-Formula-For-Expected-Value.htm) E(X) = x1p1 + x2p2 +x3p3 + . . . + xnpn. The [expected value formula](http://statistics.about.com/od/Formulas/a/What-Is-The-Formula-For-Expected-Value.htm) will be used when trying to solve problems and make decisions based on the [probability](http://dictionary.reference.com/browse/probability) of the event occurring.   
Day 2: The teacher will review the definition of [expected value](http://www.investopedia.com/terms/e/expected-value.asp) and the [formula](http://statistics.about.com/od/Formulas/a/What-Is-The-Formula-For-Expected-Value.htm) (see above). The teacher will hand out [Venn diagrams](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf) for students to fill out when taking notes or to fill out after class when they are looking over their notes. The teacher will give students the definition of [probability distribution](http://www.investopedia.com/terms/p/probabilitydistribution.asp) - describes all the possible values and their likelihood of occurring and the definition of [probability](http://dictionary.reference.com/browse/probability)- the possibility that an event will occur. The teacher will tell students what the [probability distribution formula](http://formulas.tutorvista.com/math/probability-distribution-formula.html) is. The [probability distribution formula](http://formulas.tutorvista.com/math/probability-distribution-formula.html) isNormal Probability Distribution. Students will not be responsible for knowing this and they will not use it to create the [probability distribution.](https://www.khanacademy.org/math/probability/random-variables-topic/random_variables_prob_dist/v/discrete-probability-distribution) This [formula](http://formulas.tutorvista.com/math/probability-distribution-formula.html) is being given to students so they know where it comes from. The teacher will give students examples of finding the[expected value](https://www.khanacademy.org/math/probability/random-variables-topic/expected-value/v/expected-value-wager).  
The teacher will go through some examples with the class so the students learn how to do the problems. Students will then be giving a couple of examples to do on their own. The class will then go over the problems and the teacher will prompt the students to show how they solved the problems. The teacher will then introduce the [measures of central tendency](https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php) and tell students how they relate to probability and how to find them using a probability chart. The [measures of central tendency](https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php) are [mean](https://en.wikipedia.org/wiki/Mean), [median](https://en.wikipedia.org/wiki/Median), and mode. Examples of how to find them will be given in the next class. Students will be introduced to the PostermyWall project that they will be working on with partners. The teacher will play the [tutorials](https://www.youtube.com/watch?v=SUMnbTdzPB4)(see urls list) and will show students where these tutorials can be found on her website.  
The teacher will group the students by having them work with the person who they are sitting next to. If students are sitting next to someone then the teacher will move them so they are sitting next to someone to work with. The teacher will give each partner a number, either 1 or 2. The 1's will be comparing the probability distribution and expected value. The 2's will be contrasting the probability distribution and expected value. Students will then get together will their partners and will use the remaining class time to start their projects. Students will be called up in their pairs to get laptops.  
Day 3: The teacher will redefine [measures of central tendency](https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php) (see above) and will give students formulas for finding each one using a probability chart. The teacher will go over examples in class, at least two examples for each measure of central tendency. The students will then be given examples and will try to find each one using a probability chart on their own or in pairs. The class will then go over how to do the problems. The teacher will prompt students to share with the class how they got to their answer. [The teacher will](http://edu221resources.wikispaces.com/file/view/cooperative_learning_strategies.pdf/426402320/cooperative_learning_strategies.pdf) then break the class into teams by giving each student a number 1 through 4. The 1's will be in one group, the 2's in another, etc. The teacher will give people numbers according to their mastery level. By doing this the teacher is making sure that not all the gifted kids are in one group and not all the struggling students are in a group. This activity will serve as learning stations. Each team will be at a learning station and each station will have a question regarding one of the measures of central tendency. Each station will have different measure of central tendency to review. Each station will ask a question about how expected value and the measures of central tendency relate to the probability distribution. This will help students review for the quiz they will have on the measures of central tendency in two days. The remaining class time will be used to work on the PostermyWall Project. Students will be told that whatever they don't finish will be homework because the project will be due the next class. In the beginning of the next class students will be expected to be ready to present their project to the class. If students are struggling with the content or struggling with the product they will be encouraged to come talk to the teacher during the time that is set aside in class for them to work on the project. If the teacher sees that students are struggling she will ask them to come talk to her so that she can help clear up misconceptions or help them with the project.   
Day 4: Students will be presenting their PostermyWall Projects in the beginning of class. Students will be given note cards to write feedback on for each group that presents. While other groups are presenting students will be giving their peers feedback. The feedback will be handed in to the teacher at the end of the class. The teacher will be using the checklist to give feedback while each group is presenting. After the groups are done presenting students will be given time to finish the comments on their peers product. The class will then be reviewing the [measures of central tendency](https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php). Students will be given a worksheet and will have time to complete the problems. The class will then go over the answers to the problems and they problems where there was confusion will be gone over in class. The teacher will introduce the [GeoGebra](https://www.geogebra.org/wiki/en/Probability_Calculator) project at the end of class and will show students where to find the tutorials on this technology on the teacher's website. Students will be creating a graph using GeoGebra. Students will create this product on their own. Students will be self-assessing their work as they create it. Students will be given the checklist that the teacher will use when grading the product and should make sure they have all the components on the checklist before emailing it to the teacher. Students will be given time in class to compare their products to their peers before turning in the project. Students will be allowed to refine their products after they get feedback from the teacher. For homework students will look at the tutorials for [GeoGebra](https://www.geogebra.org/wiki/en/Probability_Calculator) and study for the quiz on the measures of central tendency that will be given in the beginning of the next class period.  
Day 5: Students will be given 25 minutes to take a quiz on the measures of central tendency and how they relate to probability and the probability distribution. The rest of the class period is set aside for students to work on the graphs they will be creating in GeoGebra. The may use this time to share what they have created with their classmates and refine their product if need be. Students who are struggling with the material or with the project will be encouraged to see the teacher for help. If the teacher can tell that students are struggling they will be asked to go meet with the teacher so that she can help them with the material or the project. Whatever students don't finish in class will need to be finished outside of class. Students should share their product with the teacher by the morning before the next class period.  
  
**Handouts**  
[Venn Diagram handouts](http://www.eduplace.com/graphicorganizer/pdf/venn.pdf)  
Checklists for both products  
Pre - assessment  
Quizzes  
  
  
**Maine Common Core Teaching Standards for Initial Teacher Certification and Rationale**  
**Standard 1 –Learner Development. The teacher understands how learners grow and develop,recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.**  
  
**Learning Styles**  
**Clipboard:** The teacher will be addressing students that are clipboards by having graphic organizers so students can organize their work before using it in the products. In this lesson students will be provided with a Venn Diagram to compare and contrast expected value and the probability distribution which they can use when making their posters using PostermyWall.com  
**Microscope:** Students will be discussing the material in teams when playing Rally Robin. They will also be discussing with their partners for the PostermyWall project.   
**Puppy:** The teacher will provide a safe environment for students by going over respectful behavior on the first day of class and by helping students peer review without making mean negative comments but by making critiques that are stated nicely and will be helpful to students.  
**Beach Ball:** Students will have personal freedom when creating their posters. They can use a wide variety of resources to make their poster and they can add any pictures they would like as long as they can explain how the picture relates to the probability distribution and expected value.   
  
**Rationale:** It is important to address all of these learning styles because in my classroom I will have students with each learning style and they all need to be able to learn in a way that best suits them.  
  
**Standard 6 - Assessment. The teacher understands and uses multiple methods of assessment to engage learners in their on growth,to monitor learner progress, and to guide the teacher's and learner's decision making.**  
  
**Formative:**   
[Bubble Wrap](http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf) - students will place sticky notes of what they what to learn in the course and what will be taught in the course on a bubble. Once students feel they have a good understanding of the topic they will pop the bubble that has that sticky note on it.  
[Quiz](http://edu221spring11class.wikispaces.com/file/view/strategies.pdf/200849872/strategies.pdf) - students will take a quiz on the measures of central tendency and how they relate to probability and the probability distribution.  
**Summative:**   
PostermyWall - students will be working in pairs to create a PostermyWall. One person will compare expected value and the probability distribution and the other person will contrast them. Both students will be responsible for putting together the PostermyWall. Students will be peer reviewing other pairs PostermyWall.  
GeoGebra - students will be working individually but they will share their product with another student in class to compare their product with someone else's product.  
**Rationale:**  
I am using the formative assessments to make sure that students have the ability to determine when they have a deep understanding by having them pop the bubbles when they feel they understand it. I am using the quiz to make sure that students know how the measures of central tendency relate to what we will be doing for the rest of the unit. The poster will show me that students understand the similarities between the two. The GeoGebra product will show that students know how to use the technology and that they know how to label a graph.  
  
**Standard 7 - Planning Instruction. The teacher plans instruction that supports every student in meeting rigorous learning goals by drawing upon knowledge of content areas, curriculum,cross-disciplinary skills, and pedagogy, as well as knowledge of learners and the community context.**  
  
**Content Knowledge:**  
Students will know [probability](http://dictionary.reference.com/browse/probability) - the possibility that an event will occur, [expected value](http://www.investopedia.com/terms/e/expected-value.asp) - the predicted value for a given event, [probability distribution](http://www.investopedia.com/terms/p/probabilitydistribution.asp) - describes all the possible values and their likelihood of occurring, [random variable](https://en.wikipedia.org/wiki/Random_variable) - a variable whose value is subject to variations due to chance, [mean](https://en.wikipedia.org/wiki/Mean) - used as a synonym for expected value, [median](https://en.wikipedia.org/wiki/Median) - the number that separates the higher half of the data sample from the lower half, [standard deviation](https://en.wikipedia.org/wiki/Standard_deviation) - the number that is used to describe how much the data varies from the mean, [standard error](http://www.investopedia.com/terms/s/standard-error.asp) - the standard deviation of the sampling distribution,[expected value formula](http://statistics.about.com/od/Formulas/a/What-Is-The-Formula-For-Expected-Value.htm) - E(X) = x1p1 + x2p2 + x3p3 + . . . + xnpn., [probability distribution formula](http://formulas.tutorvista.com/math/probability-distribution-formula.html) -Normal Probability Distribution

**MLR or CCSS or NGSS**  
**Common Core State Standards**  
**Content Area**: Statistics and Probability  
**Grade Level**: High School  
**Domain**: Using Probability to Make Decisions  
**Cluster**: Calculate expected values and use them to solve problems  
**Standards**: 2. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.  
**Facet:** Explain and Perspective  
**Rationale:** I choose this standard because the teacher will be teaching the students how to calculate expected value and will be showing the students what the probability distribution looks like on a graph to address this standard. The students will be comparing the two in a formative assessment which also addresses this standard.   
  
**Standard 8 - Instructional Strategies. The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to apply knowledge in meaningful ways.**  
  
**MI Strategies:**   
**Verbal:** Students will be talking with their peers about how they think mean, median, etc. relate to the probability distribution during Rally Robin.  
**Logic:** Students will be thinking about what they want to know for the pop it activity.  
**Visual:** Students will be creating a Venn Diagram that compares and contrasts the probability distribution and expected value.  
**Musical:** Students will listen to the Probability Song on YouTube.  
**Intrapersonal:** Students will create the probability distribution on GeoGebra and label its part on their own.  
**Interpersonal:** Students will work in pairs to create a PostermyWall that compares and contrasts the probability distribution and expected value.  
**SAMR:**   
Students will create a poster on PostermyWall comparing expected value and the probability distribution. This is at the augmentation level because students will have effects (pictures coming in at different times) on their posters.  
Students will create a graph of the probability distribution using GeoGebra. This is at the augmentation level because students can plot points and have GeoGebra create the graph and label the points. Students can also change the colors of the points and name them based on what it is instead of having point A and point B.  
  
**Rationale:**  
The MI's that are being used in this lesson are differentiating instruction because they are helping students with different learning styles be successful in this class. By satisfying multiple intelligences, the teacher is giving all students an equal opportunity to learn no matter what intelligence they learn best in. The postermywall project promotes higher order thinking because students have to think about what pictures they want to use on their posters to represent the probability distribution and expected value. Students also have to think about when they want their pictures and text appearing on the poster since they will have the elements of the poster coming in at different times.   
  
  
**NETS STANDARDS FOR TEACHERS**  
**1. Facilitates and Inspire Student Learning and Creativity. Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.**  
a. Promote, support, and model creative and innovative thinking and inventiveness  
  
b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources  
  
c. Promote student reflection using collaborative tools to reveal and clarify students’ conceptual understanding and thinking, planning, and creative processes  
  
d. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments  
  
**Rationale:** A. The teacher will be promoting and supporting creative and innovative thinking by giving students "free range" on the pictures that they use on their Posters.  
  
**2. Design and Develop Digital Age Learning Experiences and Assessments. Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop knowledge, skills, and attitudes identified in the NETS-S.**  
a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity  
  
b. Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress  
  
c. Customize and personalize learning activities to address students’ diverse learning styles, working strategies, and abilities using digital tools and resources  
  
d. Provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching  
  
**Rationale:** A, C, and D. The students will use digital tools for their projects. The teacher is using different learning styles through the lesson and in the products that the students are creating. The teacher is using technology for the summative assessments in this lesson.